REMARKS/ARGUMENTS

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

Claims 1-4 were rejected under 35 USC 103(a) as being unpatentable over Nakae et al. in view of Garvie et al. or Scott, Jr. Applicant respectfully traverses this rejection.

The Examiner alleges that Nakae discloses a sensor portion and a heater member with one and other surfaces as recited in claim 1, but the Examiner recognizes that Nakae does not disclose that the other surface of the heater member has the roughness specified in claim 1.

The Examiner alleges that both Garvie and Scott teach that polished alumina surfaces have greater mechanical strength than unpolished alumina. Thus, the Examiner alleges that it would have been obvious to a skilled person in this art to polish the exposed alumina surface of Nakae, based on the teaching of either Garvie or Scott, so as to improve the mechanical strength of the underlying alumina surface.

However, a purpose of the present invention is not to improve the mechanical strength of the other surface of the heater member, but to cause the heater member to have a high reliability against water cracks. In order to achieve this, the gas sensor element of applicant's claim 1 is configured such that the other surface of the heater member has a ten points average roughness, the ten points average roughness being no more than 1.71 μm. The specified ten-points average roughness of the other surface of the heater member recited in applicant's claim 1 allows the other surface thereof to repel drops of water to thereby improve the reliability against water cracks.

If the other surface is simply polished, in order to improve the mechanical strength of the other surface of the heater member, the other surface would be polished without guidance or limitation, as in Garvie or Scott. However, in such a case, as clearly illustrated in the table 1, the graph of Fig. 7, and Fig. 9, when the polishing of the other surface causes

the ten points average roughness thereof to be more than 1.71 μm, the surface tension of the other surface 171 of the heater member is reduced. This causes a water drop 179 falling into the other surface 171 to be widely spread over the other surface, so that the contacting area of the other surface 171 with the water drop 179 is wide, so that the tensile stress 181 around the contacting portion is increased, which causes water cracks in the heater member.

Specifically, if the skilled person polishes the other surface of the heater member simply in order to improve the mechanical strength of the other surface, there is no obvious reason why the skilled person would be motivated to continue polishing until the ten points average roughness of the other surface becomes no more than 1.71 μm.

However, in order for the heating member to have a high reliability against water cracks, applicant has focused on the relationship between the ten points average roughness of the other surface of the heater member and the water repellency thereof. Specifically, as clearly illustrated in the table 1, the graph of Fig. 7, and Fig. 8, when the ten points average roughness of the other surface 171 of the heater member is no more than 1.71 μm, the water drop 179 falling into the other surface of the heater member is repelled by the other surface so as to be rounded. This allows the contacting area of the other surface 171 to the water drop 179 to be reduced. Because the contacting area of the other surface 171 to the water drop 179 is reduced, the tensile stress 181 around the contacting area is reduced, which can prevent water cracks from occurring in the heater member. This makes it possible to achieve the purpose of the present invention.

Thus, the polishing of the other surface of the heater member with only routine skill in the art, without any reference to the specified ten points average roughness recited in applicant's claim 1, may not obtain the effect of preventing water cracks from occurring in the heater member.

As argued above, it is respectfully submitted that the purpose of the present invention is not disclosed, suggested, or taught at all in Nakae, Garvie, and Scott, alone or

in combination, and the concept of applicant's claim 1 to achieve this purpose is not disclosed, suggested, or taught at all in Nakae, Garvie, and/or Scott.

Accordingly, it is respectfully submitted that applicant's claims 1-4 are not obvious from Nakae, Garvie, and/or Scott, taken alone or in combination.

Claims 1, 2, 4 and 7 were rejected under 35 USC 103(a) as being unpatentable over Nakae in view of Hata et al. Applicant respectfully traverses this rejection.

Regarding claim 7, the Examiner alleges that Nakae discloses preparing a sensor portion, and preparing a heater member with one and other surfaces as recited in claim 7, laminating the sensor portion to a heater portion of the heater member, and firing the laminated sensor portion and the heater member. The Examiner recognizes, however, that Nakae does not recite anything about the base member utilized for the firing step, and hence does not disclose the use of a base member having a ten points average roughness; this ten points roughness being no more than approximately 8.55 um.

The Examiner alleges that Hata teaches, in an alternate firing process for zilconia, that spacers 3 upon which green sheets 2 are placed for firing should be polished fine down to a surface roughness of less than 5 μm or 2 μm so as to readily slide the green sheets 2 on the spacers 3 during the firing. Thus, the Examiner alleges that it would have been obvious to one skilled person in this art to polish a base member for Nakae so as to improve the slidability of a green sheet of Nakae placed on the base member.

However, as described above, the purpose of the present invention is not to improve the slidability of a mount surface of the base member on which the other surface of the heater member is contacted, but to cause the heater member to have a high reliability against water cracks. In order to achieve the purpose, the method of applicant's claim 7 specifies that the mount surface of the base member on which the other surface of the heater member is contacted has a ten points average roughness, the ten points average roughness being no more than 8.55 μm.

Specifically, as clearly described on page 19, applicant found out that, after the other surface of the heater member mounted on the mount surface of the base member is fired, the surface roughness of the other surface of the heater member is approximately one-tenth (1/10) to one fifth (1/5) of the surface roughness of the mount surface of the base member. Based on the relationship between the surface roughness of the other surface of the heater member and that of the mount surface of the base member, adjusting of the ten-points average roughness of the mount surface of the base member to 8.55 μm allows the ten-points average roughness of the other surface of the heater member after firing to be set to being no more than 1.71 μm (8.55/5 = 1.71). As set forth above, the specified ten-points average roughness of the other surface of the heater member (recited in applicant's claim 1) allows the other surface thereof to repel drops of water to thereby improve the reliability against water cracks.

If the skilled person polishes the mount surface of the base member in order to merely improve the slidability of the other surface, there is no obvious reason why the skilled person would be motivated to continue the polishing until the ten points average roughness of the mount surface becomes no more than 8.55 μm. In other words, the polishing of the mount surface of the base member with only routine skill in the art without any reference to the specified ten points average roughness recited in applicant's claim 7 may not obtain the effect of preventing water cracks from occurring in the heater member.

As argued above, it is respectfully submitted that the purpose of the present invention is not disclosed, suggested, or taught at all in Nakae and Hata, alone or in combination, and therefore, the subject matter of applicant's claims 1, 2, 4, and 7 to achieve the purpose is not disclosed, suggested, or taught at all in Nakae and Hata, whether taken alone or in combination.

Accordingly, it is respectfully submitted that applicant's claim 1, 2, 4, and 7 are not obvious from Nakae and Hata.

Claims 5 and 6 were rejected under 35 USC 103(a) as being unpatentable over Nakae in view of Kato and either Garvie or Scott. Applicant respectfully traverses this rejection.

Claims 5 and 6 are submitted to be patentable over Nakae, Garvie and/or Scott for the reasons advanced above. The Examiner's further reliance on Kato does not overcome the deficiencies of the primary combination noted above. It is therefore respectfully submitted that the claims are patentable over this prior art combination as well.

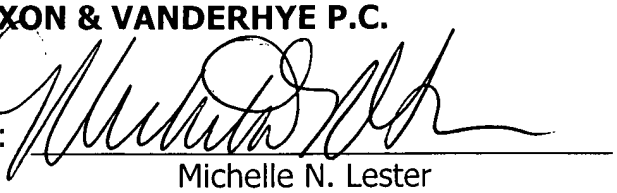
Claim 8 was rejected under 35 USC 103(a) as unpatentable over Nakae in view of Kato, Garvie or Scott, and Hata. Applicant respectfully traverses this rejection.

Claim 8 is submitted to be patentable over Nakae, Garvie, Scott and/or Hata for the reasons advanced above. The Examiner's further reliance on Kato does not overcome the deficiencies of the primary combination noted above. It is therefore respectfully submitted that claim 8 is also patentable over this prior art combination as well.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and an early Notice to that effect is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 

Michelle N. Lester
Reg. No. 32,331

MNL:slj
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100